| **Question** | **Scheme** | **Marks** |
| --- | --- | --- |
| **1(a)** |  | M1 |
| or 2 – 2i or exact equivalent. | A1 |
|  |  | **(2)** |
| **1(b)** |  | M1 |
|  = – 8i | A1 cao |
|  |  | **(2)** |
| **1(c)** | If *z* is a root so is *z*\* So ( *x* – 2 + 2 i)(*x* – 2 – 2 i) (or **)**  | M1 |
| So ( *x* – 2 + 2 i)(*x* – 2 – 2 i) = 0 (or )and so *p* = *q* =  | M1 |
| Equation is or *p* = – 4 and *q* = 8 | A1 |
|  |  | **(3)** |
|  |  | **(7 marks)** |
| **2(a)** | , or equivalent | M1A1 |
| Solving 3-term quadratic by formula or completion of the square or  | M1 |
|  | A1 A1ft |
|  | 5*O* | **(5)** |
| **2(b)** |  |  |
|  |  ` | Two roots on imaginary axis | B1ft |
| Two roots – one the conjugate of the other | B1ft |
|  |  Accept points or vectors | **(2)** |
|  |  | **(7 marks)** |
| **3(a)** |  |  | B1 |
|  | Attempt to expand  or any valid method to establish the quadratic factor e.g. Sum of roots 6, product of roots 10 | M1 |
|  | Attempt at linear factor with their *cd* in   Or Or attempts f(2) | M1 |
|  |  | A1 |
|  | **Showing that** *f*(2) = 0 **is equivalent to scoring both M’s so it is possible to gain all 4 marks quite easily e.g.**  **B1, shows** *f*(2) **=** 0 **M2,**  **A1. Answers only can score 4/4** | **(4)** |
| **3(b)** | **Argand Diagram**3, 13, -12, 0-1.5-1-0.500.511.500.511.522.533.5ReIm | B1B1 |
| First B1 for plotting (3, 1) and (3, -1) correctly with an indication of scale or labelled with coordinates (allow points/lines/crosses/vectors etc.) Allow *i*/-*i* for 1/-1 marked on imaginary axis.Second B1 for plotting (2, 0) correctly relative to the conjugate pair with an indication of scale or labelled with coordinates or just 2 |  |
|  |  | **(2)** |
|  |  | **(6 marks)** |
| **4(a)** | *x*3 + *ax*2 + *bx* – 52 = 0, *a*, *b* ∈ ℝ |  |
|  | B1 |
|  |  | **(1)** |
| **4(b)** |  or;  | M1A1 |
|  | M1 |
|  or  | A1A1 |
|  |  | **(5)** |
|  |  | **(6 marks)** |
| **5** |  |  |  |
|  |  | B1 |
|  | Substituting  and their *z*\* into   | M1 |
|  | Correct equation in *x* and *y* with i2 = -1. Can be implied. | A1 |
|  |  |  |
|  | An attempt to equate real **and** imaginary parts. | M1 |
|  | Correct equations. | A1 |
|  |  |  |
|  | Attempt to solve simultaneous equations to find one of *x* or *y*. **At least one of the equations must contain both *x* and *y* terms.** | M1 |
|  | Both  and  | A1 |
|  |  | **(7)** |
|  |  |  | **(7 marks)** |
| **6(a)** |  So  or  | M1M1A1A1 |
|  |  | **(4)** |
| **6(b)** | and so  | B1 |
|  |  | **(1)** |
| **6(c)** |  | B1 |
|   | M1A1 |
|  |  | **(3)** |
| **6(d)** |   | M1A1 B1ft |
|  |  | **(3)** |
| **6(e)** | *OP* and *QR* are parallel , and *QR* is twice the length of *OP***Or** Enlargement with Scale Factor 2 (centre *O*), followed by translation   | B1B1 |
|  |  | **(2)** |
|  |  | **(13 marks)** |
| **7(a)** |  |  |
|  | M1 |
|   | A1 cao |
|  |  | **(2)** |
| **7(b)** |  | M1 |
|  | B1 |
|  | dM1A1 |
|  |  | **(4)** |
| **7(c)** |  | M1 |
|     | dM1 |
| *a* = 1, *b* = -1 | A1 |
|  |  | **(3)** |
| **7(d)** |  | M1 |
|   | A1 |
|  |  | **(2)** |
|  |  | **(11 marks)** |
| **8(a)** |  | M1 |
|  | A1 |
|  |  | **(2)** |
| **8(b)** |   | M1 |
|   (Note:  | M1A1 |
|  |  | **(3)** |
| **8(c)** |  | M1 |
|  | **d**M1 |
|  | M1 |
|  (Note:  | A1 |
|  |  | **(4)** |
| **8(d)** | , and  |  |
|  |  |
| So real part of  = 0 or  | M1 |
| So,  | A1 |
|  |  | **(2)** |
|  |  | **(11 marks)** |
| **9(a)** | -7-24 ImRe  | Correct quadrant with  indicated. | B1 |
|  |  |  | **(1)** |
| **9(b)** |  |  or  | M1 |
|  | awrt -2.86 or awrt 3.43 | A1 |
|  |  |  | **(2)** |
| **9(c)** |  |  |  |
|  |  |  |
|  | Attempt to apply   | M1 |
|  | Correct expression for *w*. | A1 |
|  |  |  |
|  | either  or   | A1 |
|  |  |  | **(3)** |
| **9(d)** |  |  |  |
|  |  or i or awrt 97.1-23.8i | B1 |
|  |  |  |
|  | Applies or   | M1 |
|  | 100 | A1 |
|  |  |  | **(3)** |
|  |  | **(9 marks)** |
| **10(a)** |   | M1 |
|  | M1 A1 |
|  |  |
|  |  |
|  | M1 |
|  | A1 A1 |
|  |  | **(6)** |
| **10(b)** |     | Centre in correct quad for their circle  | M1 |
| Passes through O centre in 4th quad. | A1cao |
| Half line with positive gradient | B1 |
| Correct position, clearly through (6, 0) | B1 |
|  |  | **(4)** |
| **10(c)** | Equation of line  | B1 |
| Attempting simultaneous solution of  and  | M1 |
|  | A1 |
|  | A1cao |
|  |  | **(4)** |
|  |  | **(14 marks)** |
| **11(a)** |  |  |
| 11.1803... | B1 |
|  | M1 |
|  | A1 oe |
|  |  | **(2)** |
| **11(b)** |  |  |
|  | B1 |
|  | M1 |
|  | M1 |
|  |  |
|   |  |
|  (Note:  | A1 |
|  |  | **(4)** |
| **11(c)** |  |  |
|  |  |
|  | M1 |
| So,  | A1 |
|  |  | **(2)** |
|  |  | **(9 marks)** |

|  |  |  |  |  |  |
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|  | **Source paper** | **Question number** | **New spec references** | **Question description** | **New AOs** |
| 1 | FP1 2016 | 4 |   | Complex numbers | 1.1b, 3.1a |
| 2 | FP1 Jan 2013 | 5 |   | Complex numbers | 1.1b, 3.1a |
| 3 | FP1 Jan 2012 | 5 |   | Complex numbers | 1.1b, 3.1a |
| 4 | FP1 2017 | 6 |   | Complex numbers | 1.1b, 3.1a |
| 5 | FP1 2011 | 6 |   | Complex numbers | 1.1b |
| 6 | FP1 2016 | 7 |   | Complex numbers | 1.1b, 2.1, 3.1a |
| 7 | FP1 2013 | 7 |   | Complex numbers | 1.1b, 3.1a |
| 8 | FP1 2012 | 7 |   | Complex numbers | 1.1b, 3.1a |
| 9 | FP1 2011 | 7 |   | Complex numbers | 1.1b, 3.1a |
| 10 | FP2 2012 | 8 |   | Further complex numbers | 1.1b, 2.1, 3.1a |
| 11 | FP1 2013R | 9 |   | Complex numbers | 1.1b, 3.1a |